the product of a partial, and in many instances of a pretty thorough alteration of the original corundum into micaceous and chloritic schists or beds, or, as Prof. Dana would express it: "*a pseudomorphism on a broad scale.*"

UNIVERSITY OF PENNSYLVANIA, July 4th, 1874.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

NO. II.

ON AN IMPROVEMENT OF THE BURETTE VALVE.

BY GEO. A. KOENIG, PH.D.

(*Read before the American Philosophical Society, August* 21, 1874).

Strictest simplicity of construction must be considered as the first requirement of any tool or apparatus, besides fitness for all work within its sphere of action. Frequently we meet with constructions in which fitness has been sacrificed to a considerable extent for the sake of simplicity, and quite as often the reverse. There are cases, indeed, in which circumstances demand even a certain degree of one-sidedness, but in my judgment a more complicated apparatus, overcoming defects of working attached to a simpler device, is practically the more desirable of the two.

When Frederick Mohr gave his rubber tube valve to volumetric analysis, he had indeed hit, like a true genius, upon the simplest contrivance imaginable. To this piece of apparatus must be ascribed the rapid adoption of volumetrical determinations by analytical chemistry. No matter how simple the volumetrical reactions might be, if they had to be executed by an unhandy manipulation, the practical chemist would rather keep on with his accustomed precipitations and weighings.

Let us consider now the conditions under which the burette will satisfy all demands which can be made upon it.

1. *The instrument must not engage the hands of the operator during the operation.*

This condition requires the burette to be fixed and its position to be quite independent from the person of the manipulator.

2. *The instrument must allow a rapid discharge of its liquid contents to any desired volume, without the application of another force than that of gravitation.*

This condition requires the tube to be fixed vertically and to be furnished with a valve.

3. *The valve must allow to interrupt the current instantaneously and completely, and also the regulation of the liquid current from the smallest drop to a full stream.*

4. *The working of the valve must be easy, not require any effort on the*

part of the operator, by which the latter's attention is necessarily detracted from the observation of the reaction.

5. *The apparatus must not come out of order easily under ordinary circumstances and attentive manipulation.*

6. *The instrument must be applicable to all solutions used in volumetric determinations.*

The present forms of the burette are of two types : a, the *dropping burette*, which in its simplest form is a graduated, lipped glass vessel, from which the solution is poured out by the lip.

Gay-Lussac improved this primitive instrument by the appendage of a capilar tube, which although preventing a sudden stream, when but a drop is wanted, still does not come up with the above given conditions except the last, and is altogether an unhandy piece of apparatus.

b, *The valve burette.* The very imperfect instrument just mentioned stimulated invention, and we find as the next step the graduated tube fixed to a stand vertically, and furnished with a glass ground perforated stop-cock. This instrument is very nearly perfect. if well executed, but from the nature of things it cannot fill the conditions 4 and 5. The rough surface produced by grinding is exceedingly disposed to capilar action and soon the effects from this show themselves by a layer of crystals cementing the cock completely. These working defects are, however, so well known, that I need hardly dwell any longer upon them. The same applies to Geissler's glass-rod stopper.

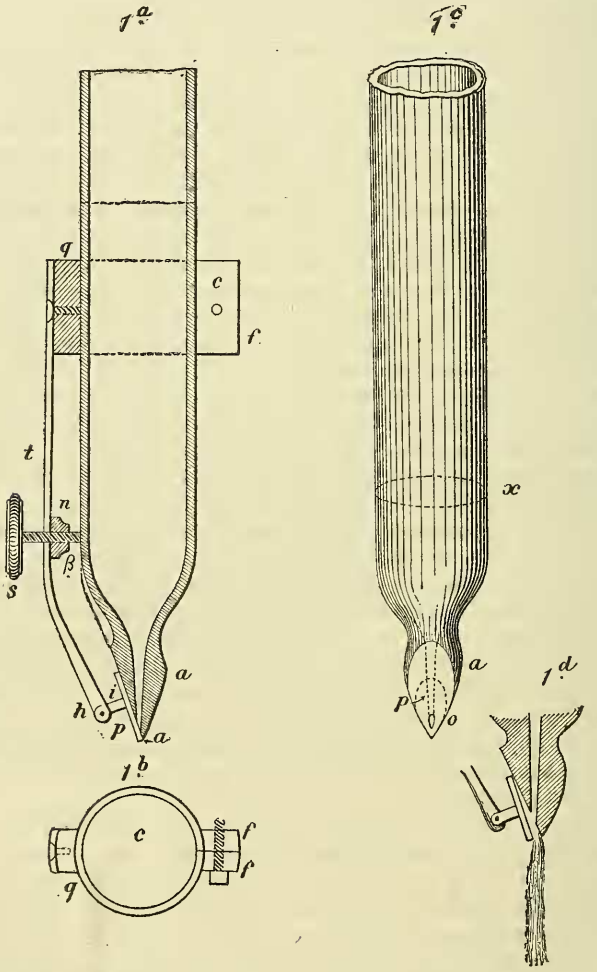
Then, Mohr showed how simply these difficulties could be overcome by connecting the neck of the tube and the mouth with a piece of India rubber tube pressed together by a spring clamp, or pinch cork. Comparing this device with the 6 conditions, we find, after a long practice, that it is far from being satisfactory. If the spring is strong it requires a remarkable muscular exertion to open it, besides destroying the elasticity of the rubber ; if weak, it will not close the valve completely. I find, moreover, that the rubber tube becomes soon deteriorated chemically, especially by alkaline solutions, and that many volumetric solutions cannot be brought into contact with such a large surface of rubber without undergoing a change in their docimastical value. The substitution of Hoffmann's screw clamp for the spring clamp is not so very happy ; it requires both hands for the adjustment just in the moment when one hand is most needed for stirring the liquid, besides it acts too slowly, several turns of the screw being needed to overcome the elasticity of the comparatively thick rubber tubing.

J. Blodget Britton described an apparatus (Journal of the Franklin Institute, 1870,) which is undoubtedly a considerable step forward. He recognized that the valve had to be placed externally, and that it had to possess a screw movement. He draws his burette at the lower end into a capilar tube, bends it slightly, so as to bring the orifice in contact with a cork plate, which itself is fastened to a steel spring, opened by a screw bolt. To prevent splashing, the opening must be very narrow, and con-

sequently the emptying of the burette requires a considerable extent of time. But otherwise the apparatus is quite perfect and neat in its execution.

I shall proceed now with the description of a device, which has realized my expectations as to the possibility of combining the advantages of Mohr's principle with universal applicability and convenience of handling.

1, *The burette.* I take a Mohr burette tube, as it is furnished by the

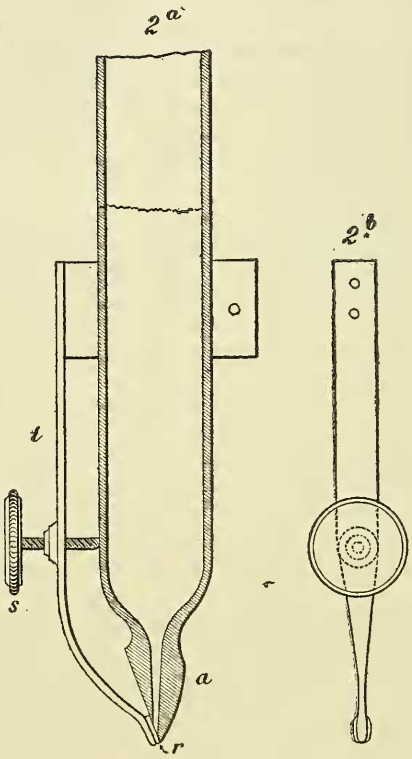


trade, hold the inflated part of the neck (serving for a hold to the rubber) over a Bunsen flame and let it contract slowly at a dull-red heat, until the channel has become capilar as shown in figures 1a, 1c and 2a of the accompanying plate. It needs hardly to be remarked, that during the process, the tube has to be kept revolving, and allowed to cool slowly. The glass wall has become very thick and strong, facilitating the next process of grinding. This is done upon an ordinary rotary grindstone in from 8 to 10 minutes. I grind off one-half of the inflation at a steep angle, as shown in the figures. The orifice is not required to have a definite size and is naturally given by the points α, β. The grinding is continued until the elliptic section of the channel has come with its lowest point from about 1-16 to 1–8 of an inch above the lowest point of the inclined ground plane.

A very short practice affords sufficient skill to grind a very nearly plane surface. Absolute planeity is not required. The sides and back are ground next to produce a point, which is necessary for the letting out of small drops of liquid. The ground face stands at right angles to the graduation and may be put either on the right or on the left side, according to the convenience of the operator. Fig. 1c represents a front view of the ground face, with the capilar orifice at 0. The size of the latter depends on the kind of work which is to be done with the burette, as it influences the size of a drop. On my 20cc burette, divided into twentieths, I have a very narrow orifice, a drop corresponding to one-half a division. I use this burette exclusively for argentum nitrate solution. For ordinary alkalimetric work I use a burette (50cc) graduated into one-fifths and allow the drops to equal one-tenth cubic in. This opening empties the burette in one minute and a quarter, when running at full stream.

2, *The valve.* Platinum in form of a smooth plate is not acted upon materially by any of the solutions now in use for volumetrical analysis. The valve consists of a platinum plate p of elliptical shape, $\frac{3}{8}$ and 3-16 of an inch being the respective parameters. Thickness about 1-32 of an inch. To the centre of this plate is soldered the platinum stem i, the end of which is pierced by an eye. The spring t, made of brass or German silver and platinated, is screwed to the clamp c, and has a fork at its other end for the insertion of the platinum stem i, forming thus the hinge h. It carries a nut n, through which the screw s passes. In order to open the valve, the screw head is turned, when the screw bolt comes into contact with the glass tube and forces the spring backwards. The valve plate assumes then a position as represented in figure 1*d*, allowing the full stream to run straight downwards without the least splashing. The capilar orifice being elliptical, with its long axis parallel to the stream, it is evident that by reversing the screw, the orifice will close gradually, the lowest point the last, allowing a most complete regulation, and when once reduced to dropping a quarter of a turn of the screw will close totally. The only objection to this arrangement of the valve, which has presented

itself thus far, is the delicacy of the hinge. Yet I have had one in use constantly for six months past, and it works as satisfactorily as on the first day. In the hands of beginners it may come out of order sooner. The clamp *c* is made of brass tubing, with the flanges *f f* and the block *g* sol-



dered on. It is made sufficiently large to admit of variation in the diameter of the burette tubes, a strip of paper being used as a filling. The delicacy of the hinge, and to some extent the cost of the apparatus ($2.50) have prompted me to substitute a simpler construction.

Figures 2*a* and 2*b* represent this device.

The platinum plate is replaced by a piece of pure rubber sheeting, the thickness of strong paper $\frac{1}{8}$ by 3-16 of an inch, which is attached to the end of the spring by means of a solution of rubber. The lower part of the spring may be rendered proof against chemical action by galvanic platinum plating, or by a coating of rubber. The former is certainly the best, but I found by several months' experience, that a spring coated

with rubber, will resist the action of standard acids, and shows no sign of oxydation and dissolution. The rubber coating is done very quickly with a concentrated chloroformic solution. The dipping in and drying is repeated several times. I have furnished now all the burettes used by my students with this simpler contrivance ($1.00) and have found my expectations more than realized. The surface of contact between the rubber and the standard solutions is so small, that a deteriorating influence on the latter could not be noticed.

I must acknowledge my obligation to Mr. J. Zentmayer, the well-known optician and mechanician, of this city, for the practical execution of my ideas and for many valuable suggestions in the course of my experiments. Any further information that may be deemed necessary shall most gladly be given.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. III.

ON AMERICAN TELLURIUM AND BISMUTH MINERALS.

By F. A. Genth.

(*Read before the American Philosophical Society, August* 21*st*, 1874.)

On several occasions I have given descriptions and analyses of tellurium minerals, which have been found associated with the gold ores of this country. Since my last paper on this subject (Amer. Journ. of Science [2] XLV., 306–319) several highly interesting discoveries have been made, which not only augment the list of species, but also corroborate some of my former observations.

Most important is the occurrence of the tellurium ores at the Red Cloud Mine, near Goldhill, in Boulder County, Colorado. Prof. B. Silliman (Journ. of Science [3] VIII. 25–33), has given a very accurate and careful description of some of the minerals found at this locality, and an exceedingly interesting account of the geological position of the vein.

Through the liberality of my friend J. F. L. Schirmer, Esq., Superintendent of the United States Mint at Denver, Colorado, I have been put in possession of a considerable quantity of very pure and excellent material for investigation, including several varieties not mentioned by Prof. Silliman.

Another interesting locality of tellurium minerals is the Briggs or King's Mountain Gold Mine, sometimes called the Gaston Mine, in Gaston Co., N. C., where I noted this occurrence about two years ago.

A third one is in the neighborhood of Highland, Montana. Several others of minor importance will be mentioned under the different species.

The following are the results of my investigations: